

## **EARTHQUAKES – Hazard Description**

### **What is an earthquake?**

(from: 2007 Illinois Natural Hazard Mitigation Plan)

“Earthquakes occur when rocks forming the earth’s crust slip past each other along a fault. This slippage occurs when the buildup of stresses gets to the point that they are greater than the strength of the locked up section of rocks along the fault plane. When faulting takes place, the sudden release of energy produces vibrations or seismic (shock) waves that radiate from the main fault movements. These waves cause the shaking or “quaking” that lasts tens of seconds to a few minutes, depending on the magnitude of the event (energy released) and what kinds of rocks they travel through and the stiffness or lack of stiffness of the soils at a site. Where the faulting starts, at some depth below the Earth’s surface, is the hypocenter (focus) of an earthquake. The point on the surface directly above the focus is the epicenter.”

### **How are earthquakes measured?**

There are two ways to measure earthquakes.

The magnitude is a calculation of the seismic energy released and is measured through ground vibrations with a seismograph. The familiar Richter Scale is one way of reporting magnitude. The increments of magnitude are logarithmic. An increase of 0.2 on the Richter Scale indicates double the amount of energy released. For example, a magnitude 7 earthquake has about 32 times more energy than a magnitude 6 earthquake. One magnitude number is calculated for each earthquake event.

The intensity relates to the effects of an earthquake and is based on descriptions provided by people experiencing the event rather than readings from an instrument. The intensity decreases when moving away from the epicenter. The type of soil influences intensity which will be stronger through the thick, loose, saturated soils found along river valleys. The Modified Mercalli Intensity Scale is used in the United States to report earthquake intensities. Many intensities are indicated for each earthquake event based on distance from the epicenter and soil type.

Figure 5-1 shows a comparison of the Richter Scale and Modified Mercalli Intensity Scale.

### **The extent of previous earthquakes in Sangamon County.**

There is no earthquake history to speak of in Sangamon County although tremors have been felt in the past. Figure 5-2 shows earthquakes in Illinois over the past 200 years. The nearest earthquake of significant magnitude occurred on July 19, 1909 in Mason County between Petersburg and Havana. The estimated magnitude was 4.8 and no damage was recorded in Sangamon County.

On November 9, 1968 a magnitude 5.5 earthquake (the largest in the Central United States during the 20<sup>th</sup> century) occurred with an epicenter northeast of Harrisburg in Southern Illinois. The intensity felt in Sangamon County was 5 on the Modified Mercalli Intensity Scale, which indicates trembling was felt but no damage resulted.

The New Madrid fault area, located south/southwest of Illinois in the boot heel of Missouri, has the greatest potential for damaging earthquake activity. Evidence suggests that large magnitude earthquakes centered in the New Madrid area occurred in the years 300, 900, 1450, and 1811-1812. The shortest interval between events was 360 years (most recently). During the winter of 1811-1812 what is commonly known as the New Madrid earthquake occurred, but this actually consisted of four earthquakes of magnitude 7+ and hundreds of smaller

earthquakes over a several month period. At that time the area that is now Sangamon County was sparsely populated and there is no record of the intensity experienced here from these events.

Figure 5-1 The Modified Mercalli Scale v the Richter Scale (from: FEMA)

| The Modified Mercalli Scale  | Level Of Damage   | The Richter Scale |
|------------------------------|---|-------------------|
| 1-4 Instrumental to Moderate | No damage.  | <= 4.3            |
| 5 Rather Strong              | Damage negligible. Small, unstable objects displaced or upset; some dishes and glassware broken.  | 4.4 - 4.8         |
| 6 Strong                     | Damage slight. Windows, dishes, glassware broken. Furniture moved or overturned. Weak plaster and masonry cracked.  | 4.9 - 5.4         |
| 7 Very Strong                | Damage slight-moderate in well-built structures; considerable in poorly-built structures. Furniture and weak chimneys broken. Masonry damaged. Loose bricks, tiles, plaster, and stones will fall.            | 5.5 - 6.1         |
| 8 Destructive                | Structure damage considerable, particularly to poorly built structures. Chimneys, monuments, towers, elevated tanks may fail. Frame houses moved. Trees damaged. Cracks in wet ground and steep slopes.       | 6.2 - 6.5         |
| 9 Ruinous                    | Structural damage severe; some will collapse. General damage to foundations. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground; liquefaction.                              | 6.6 - 6.9         |
| 10 Disastrous                | Most masonry and frame structures/foundations destroyed. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Sand and mud shifting on beaches and flat land. | 7.0 - 7.3         |
| 11 Very Disastrous           | Few or no masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Rails bent. Widespread earth slumps and landslides.               | 7.4 - 8.1         |
| 12 Catastrophic              | Damage nearly total. Large rock masses displaces. Lines of sight and level distorted.   | > 8.1             |

Figure 5-2 Earthquakes in Illinois over the past 200 years (from: 2007 Illinois Natural Hazard Mitigation Plan)



## **The locations affected by earthquakes.**

To date there has been no earthquake damage recorded in Sangamon County. A more intense earthquake with an epicenter in Mason County would cause more costly damage in the north and west parts of the County. Another earthquake event along the New Madrid fault would more intensely affect the south/southeast parts of the County thus all of Sangamon County has some vulnerability to earthquake activity.

## **Probability of future earthquake events.**

It is difficult to calculate the probability of future earthquake events in Sangamon County since there has not been one of any significance since records have been maintained. The New Madrid seismic zone is the most studied area for earthquake activity. The US Geological Survey estimates the probability of a repeat of the 1811-1812 magnitude earthquakes is 7-10% over a 50-year time period. The Illinois State Geological Survey estimates the likelihood of a damaging earthquake (magnitude 6.3 or greater) occurring somewhere in the Central United States is 86-97% over a 50-year period.

## **EARTHQUAKES –Assessing Vulnerability**

Using HAZUS software provided by FEMA an analysis of the damages that could be caused in Sangamon County today by a recurrence of the earthquake originating in Mason County in 1909 was prepared. Although that earthquake had a magnitude of 4.8 a magnitude of 5.0 was used in the model as this appears to be the minimum value for getting accurate data from the software. Direct economic loss predicted is shown in Figure 5-3 and totals \$5,632,010. Figure 5-4 shows the areas of impact.

Figure 5-3 Total Economic Loss Estimates in Sangamon County for a Magnitude 5 Earthquake Centered in Mason County

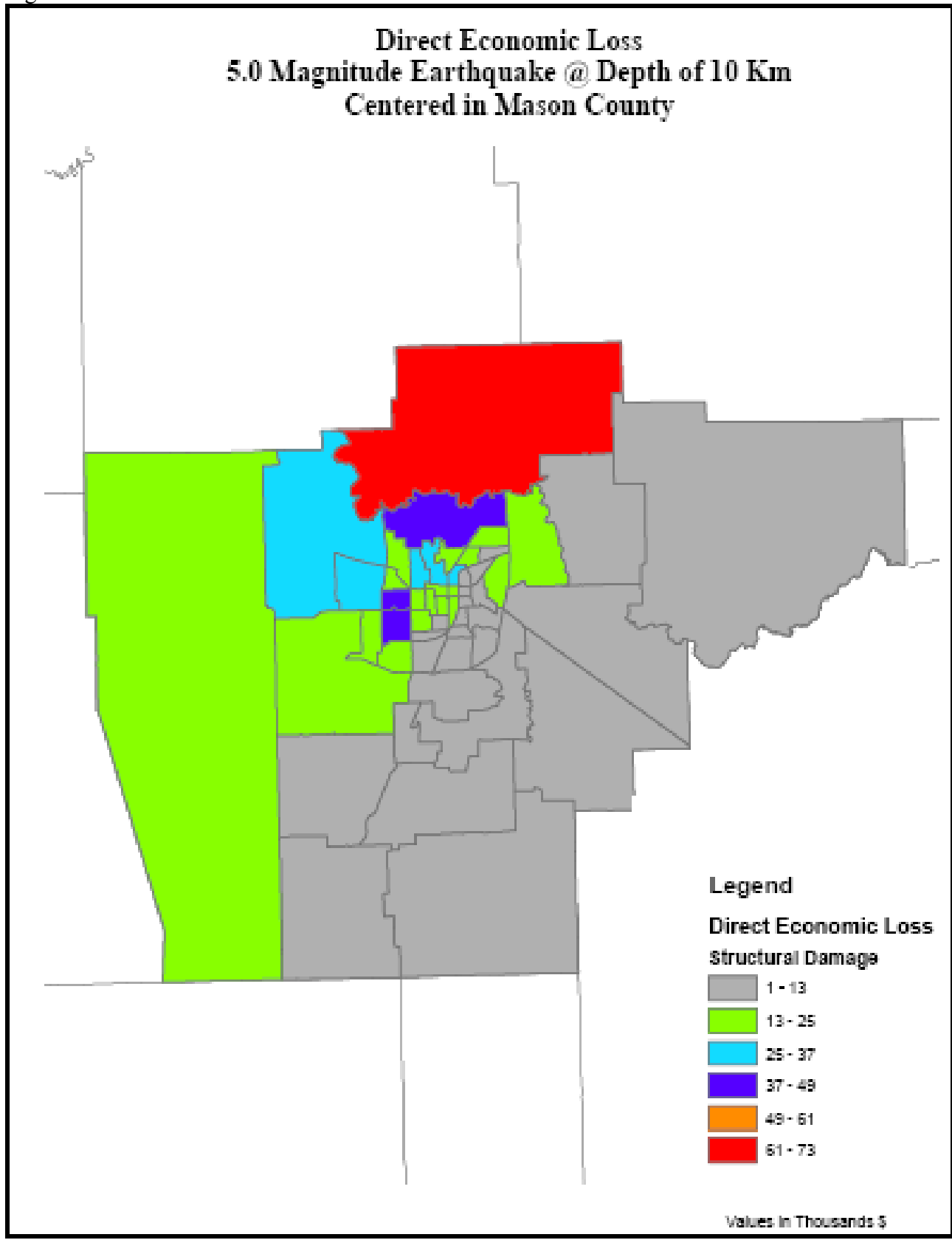
| Building Damage | Contents Damage | Inventory Loss | Relocation | Income Loss | Rental Income Loss | Wage Loss | Total Loss  |
|-----------------|-----------------|----------------|------------|-------------|--------------------|-----------|-------------|
| \$3,496,160     | \$1,345,180     | \$2,431        | \$1,754    | \$197,730   | \$262,150          | \$288,940 | \$5,632,010 |

Other notes of interest under this scenario:

- It appears most likely there would be no damage to critical facilities in Sangamon County.
- Perhaps 40 households would be displaced, five of them requiring short-term shelter.
- The north-central part of the County could be susceptible to fire.
- There could be slight damage at Abraham Lincoln Capital Airport although none to runways.
- Slight damage could be experienced by the Springfield Mass Transit District but the operation would continue to function.
- No damage is expected to roads or bridges.
- Minimal impact on other infrastructure is anticipated (utilities, communication, water, sewer).

It appears that a repeat of the Mason County earthquake would have only minimum impact on Sangamon County. The reason for the Mason County earthquake, however, is unclear as no fault line is in the area. This does present the thought that a similar earthquake could happen in Sangamon County although the likelihood of this cannot be predicted.

Figure 5-4



Another major earthquake centered in the New Madrid area could have an impact on Sangamon County, although limitations in the HAZUS software prevent using it to estimate damages and no other mechanism is available to do so. Figure 5-5 is a shaking-hazard map that shows the levels of horizontal shaking that have a 1 in 50 chance of being exceeded in a 50-year period. Shaking is expressed as a % of g with g being the acceleration of a falling object due to gravity. Sangamon County is at the lower end of the scale with 8-16 %g (green on the map) while 64 is the %g felt at the location of an epicenter.

**Figure 5-5 Shaking Hazard Map**  
(from: the US Geological Survey)

